MAGNETIC TAPE SYSTEM
GENERAL DESCRIPTION
3B20D MODEL 2 PROCESSOR

CONTENTS PAGE

CONTENTS	PAGE

1. GENERAL

1.01 This section provides physical and functional descriptions of the KS22762, L1, magnetic tape system used with the 3B20 duplex (3B20D) Model 2 processor.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

INTRODUCTION

1.03 The 3B20D Model 2 processor uses the magnetic tape to store general data, to handle call billing information, and to update the disk file system. The magnetic tape system consists of the following components:

- Tape unit (KS22762, L1)
- Peripheral controller
- Power unit (J1C134B-1 inverter).

1.04 The tape unit writes and reads nine tracks of data on a half-inch-wide magnetic tape using a phase-encoded format. It is comprised of microprocessors and mechanical assemblies. The tape unit transfers data to and from the magnetic tape while operating at a rate of 25 inches per second (IPS) in a stop/start mode. When operating in short-distance block seeks (no data transfer), the controller requests the tape drive to operate in a 25-IPS streaming mode. For long-distance block seeks, the drive is instructed to operate in a 100-IPS streaming mode and to not stop in interblock gaps. The tape unit records in a mode which is compatible with the American National Standard Institute (ANSI), Article X3.39-1973. For data operations, each unit is equipped with an integrated formatter.

1.05 The peripheral controller (UN52) resides in the input-output processor (IOP) and interfaces the IOP with the tape unit. The perpheral controller is a microprocessor system on one board. It is based on the Intel 8085A microprocessor chip. The peripheral controller decodes the IOP commands and instructs the tape unit to perform the functions. The peripheral controller communicates with the tape unit over a 50-pair transistor-transistor logic (TTL) bus within a maximum distance of 20 feet. The peripheral controller allows the tape unit to read or write data up to 40 kilobytes at a 25-IPS rate. Each block of data has a maximum of 6144 bytes. The block operation can be overlapped. Therefore, after the IOP initializes a read/write block of data, it does not have to wait for a completion from the tape formatter before setting up new commands for the same tape unit. The peripheral controller can address up to four tape units.

1.06 The tape unit requires a single-phase 120V 60-Hz power supply. The average input current of the unit is 2 amperes. The J1C134BA-1 inverter, called the 300VA inverter, supplies power to the tape unit on a one-to-one basis. The power distribution frame supplies −48V direct current to the 300VA inverter. The 300VA inverter inverts the −48V direct current to 120V alternating current and supplies it to the tape unit.

CONFIGURATION

1.07 The 3B20D Model 2 processor can support up to four tape units. The quantity of tape units is dependent upon the application of the system. If the system contains two or more tape units, the units are connected in a daisy-chain method (Fig. 1). The maximum distance between the peripheral controller and the last tape unit is 20 feet.

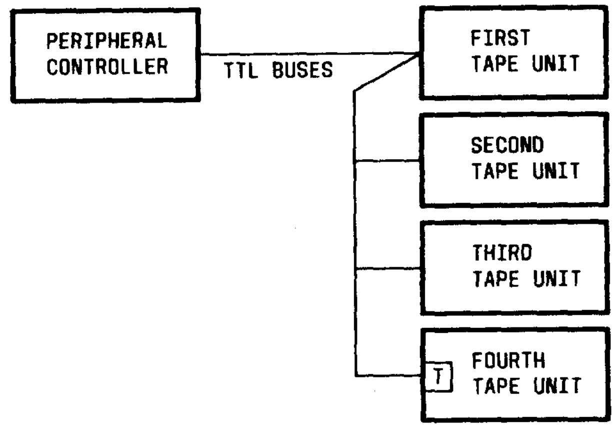


Fig. 1—Maximum System Configuration

2. PHYSICAL DESCRIPTION

2.01 The tape unit and the 300VA inverter are located on the tape unit frame (Fig. 2). The frame is standard and is 7 feet high, 2 feet 2 inches wide, and 24 inches deep. The tape unit frame can contain up to two tape units and two 300VA inverters. The tape unit is designed to be mounted in a standard rack that is 24 inches high, 19 inches wide, and 17.5 inches deep. The unit is black and weighs 100 pounds. The tape unit has a plastic, hinged, front cover for protecting the tape transport from dust and other foreign matter (Fig. 3). A transparent window in the front cover allows tape motion to be seen. The cutout in the front cover allows access to the control panel (Fig. 4). The components of the tape deck are shown in Fig. 5 and 6.

SUPPLY AND TAKE-UP REELS

2.02 The tape reel is secured to the supply hub by a mechanical latching device called the supply reel hub. The reel is latched by pressing the peripheral of the hub face while the reel is positioned against the rear flange of the hub. It is released by pressing the center button of the hub face.

2.03 The file protect assembly, located around the supply reel hub, consists of a 360-degree reflecting ring and a phototransistor sensor mounted adjacent to the reflecting ring. If a write enable ring is installed, the reflecting ring is in direct line with the sensor. If the enable ring is absent, the reflecting ring is out of the path of the sensor.

2.04 The take-up reel is a permanently mounted reel secured to the take-up motor shaft. The take-up reel motor has a 1000-segment tachometer attached. The tachometer is associated with the velocity control of the tape unit.

REEL MOTORS

2.05 The reel motors are conventional, permanent-magnet dc motors. The supply reel motor works in conjunction with the upper and lower air bearings. The supply reel motor and air bearings provide a control of tape tension across the recording surface of the magnetic head. The transducers sense the proximity of tape over the air bearings via air

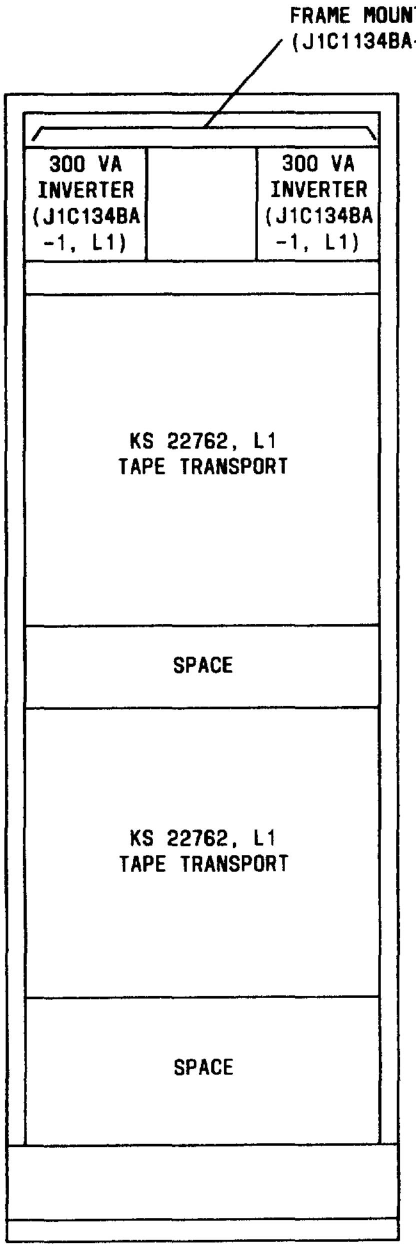


Fig. 2—Tape Transport Frame

pressure and, in effect, activate the servo. The transducers cause the servo to maintain a constant tension by increasing and decreasing the action of the supply reel motor.

POWER DRIVER AND AMPLIFIER ASSEMBLY

2.06 The power driver and amplifier assembly contains two identical power amplifiers. The first power amplifier drives the supply reel. The second power amplifier drives the take-up reel. Each power amplifier is a linear current amplifier that operates in pulse-width switching mode.

TAPE BLOCK

2.07 The beginning of tape (BOT) and the end of tape (EOT) are detected by an optical device. The optical device consists of light source and phototransistors. The phototransistor detects light from the light source, which is reflected from the BOT and EOT markers on the tape. The tape unit also uses this procedure to detect the absence of the tape. When the tape is absent, the phototransistor exposes directly to the light. The tape unit will acknowledge a changing of signal on the phototransistor, which indicates the absence of the tape.

MAGNETIC HEAD ASSEMBLY

2.08 The magnetic head is a dual gap head. It is designed to perform the read/write function in a 9-track, phase-encoded mode. A full-width erase head is provided to erase tape in the forward direction before passing the tape over the write head. Selection of the read or write operation is made by the IOP through the control logic circuits. Data is transferred to or from the IOP over TTL buses and gated to the individual head by the read/write circuit. The read recovery circuit converts the read data to a digital format compatible with the control and formatter logic. The write driver circuit converts the logic-compatible write data to the current levels required to drive the write head coils.

LOGIC CAGE ASSEMBLY

2.09 The logic cage assembly, at the rear of the tape deck, contains two printed circuit boards. They are the formatter and read/write servo boards.

FORMATTER

2.10 The formatter is equipped with microprocessor-controlled circuitry. Its functions are primarily related to data operations. The microprocessor is constructed with the 6802 microprocessor chip being the basis. The 6802 microprocessor has two 8-bit accumulators, one 8-bit condition-code register, one 16-bit stack pointer, one 16-bit program counter, and one 16-bit index register. The 6802 chip contains a 128-byte random access memory

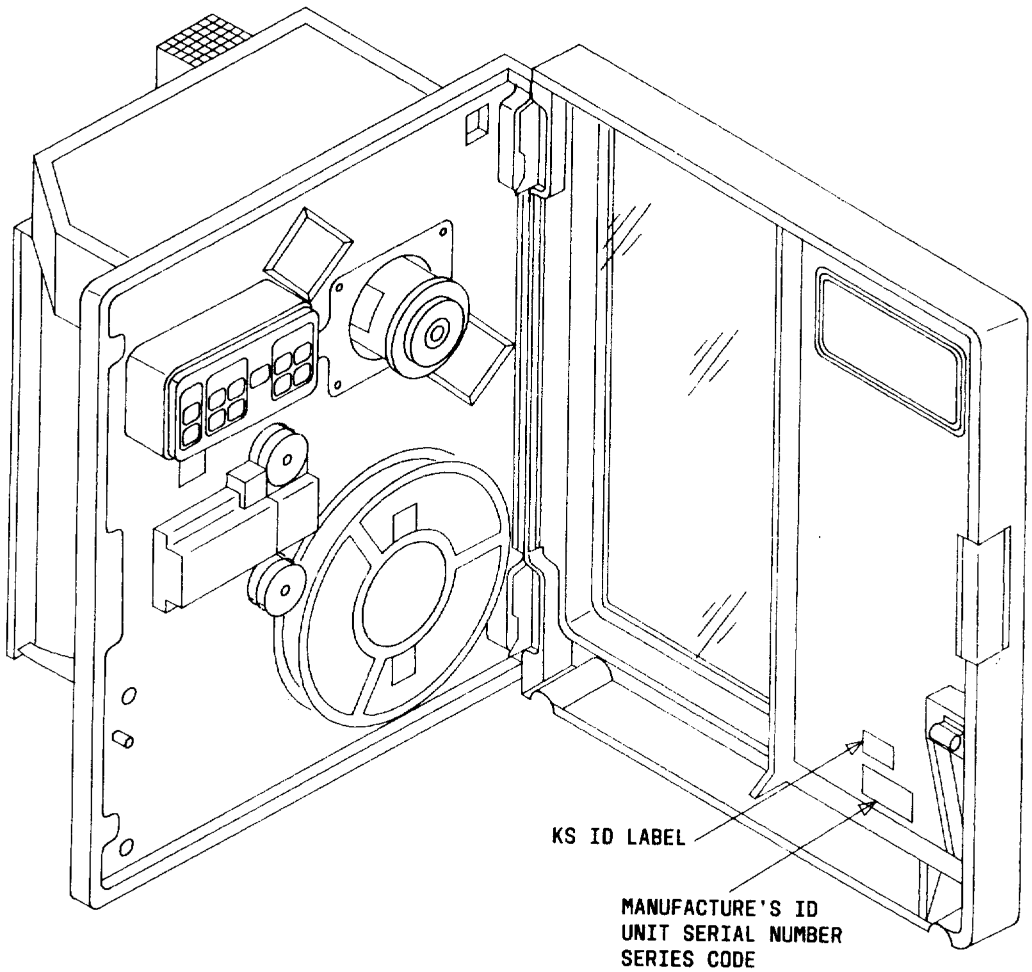


Fig. 3—KS-22762, L1, Tape Unit

(RAM) and an internal clock. The clock provides timing for the microprocessor at the rate of 3.4 MHz. All inputs and outputs of the microprocessor board are TTL compatible.

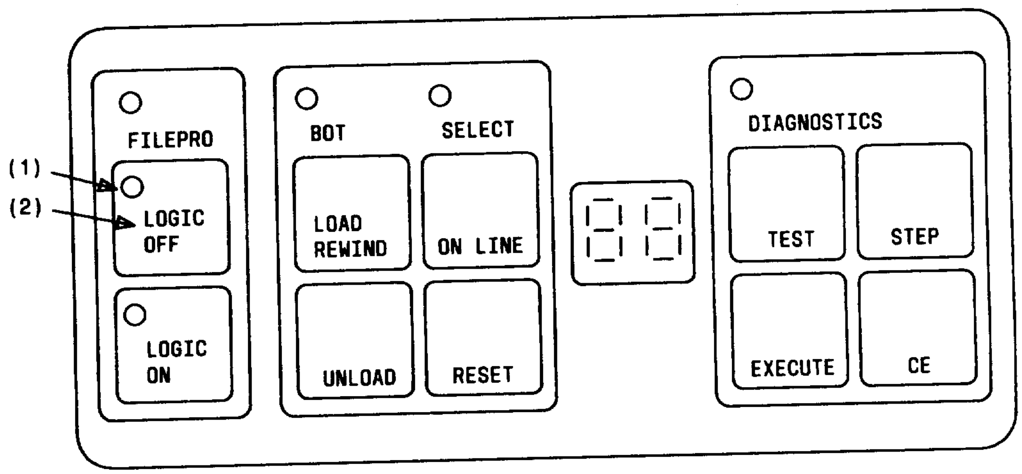
READ/WRITE SERVO

2.11 The read/write servo performs many distinct functions with circuitry on one printed circuit board. The basic circuitries on the board are as follows:

- Microprocessor and associated hardware
- Servo for the take-up and supply reels
- Head write drivers and write current programmable regulator
- Head read amplifiers with envelope detection and clip voltage generation circuits.

ADAPTER INTERFACE

2.12 The interface of the tape unit is based on the Industry Standard Interface for a half-inch tape product. The adapter interface in this case is an MC6821 peripheral interface adapter (PIA). The PIA is a programmable device, which interfaces the 6802 microprocessor with the read/write control logic.



(1) INDICATOR
(2) SWITCH

Fig. 4—Operator Control Panel

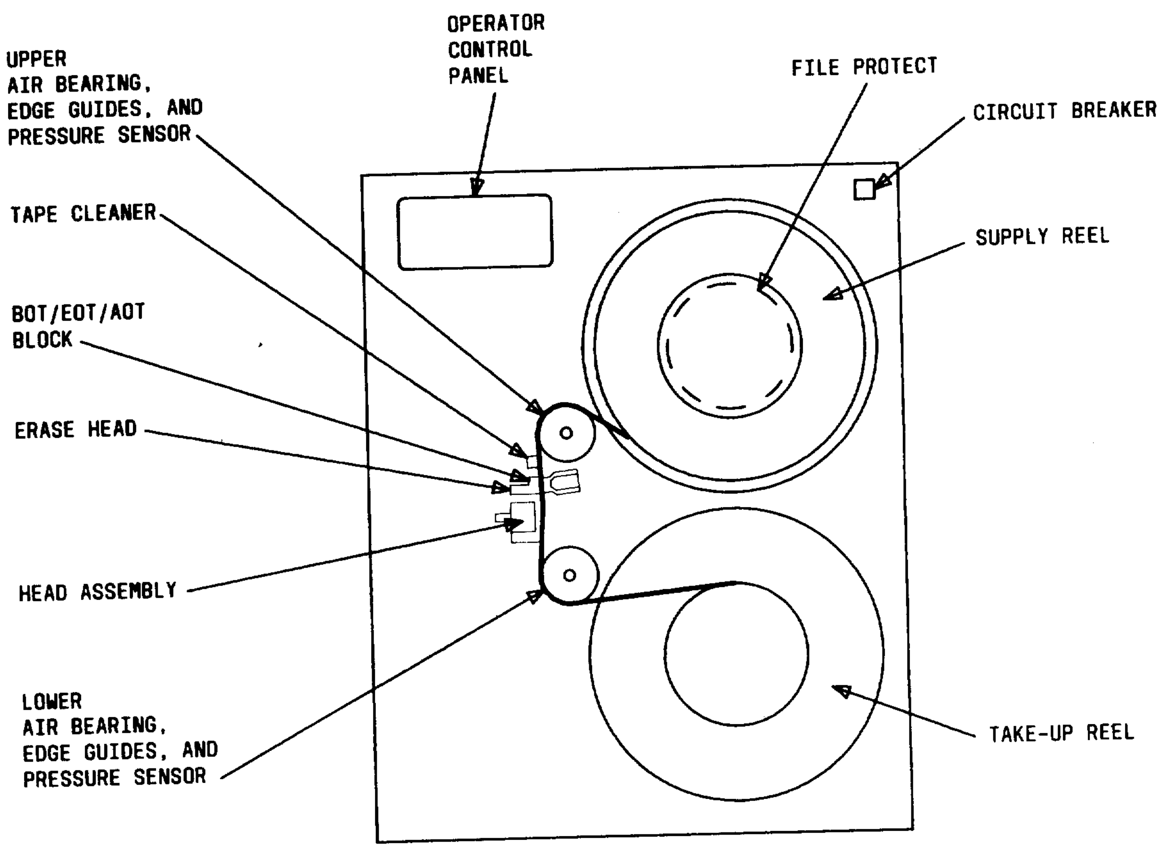


Fig. 5—Tape Deck (Front View)

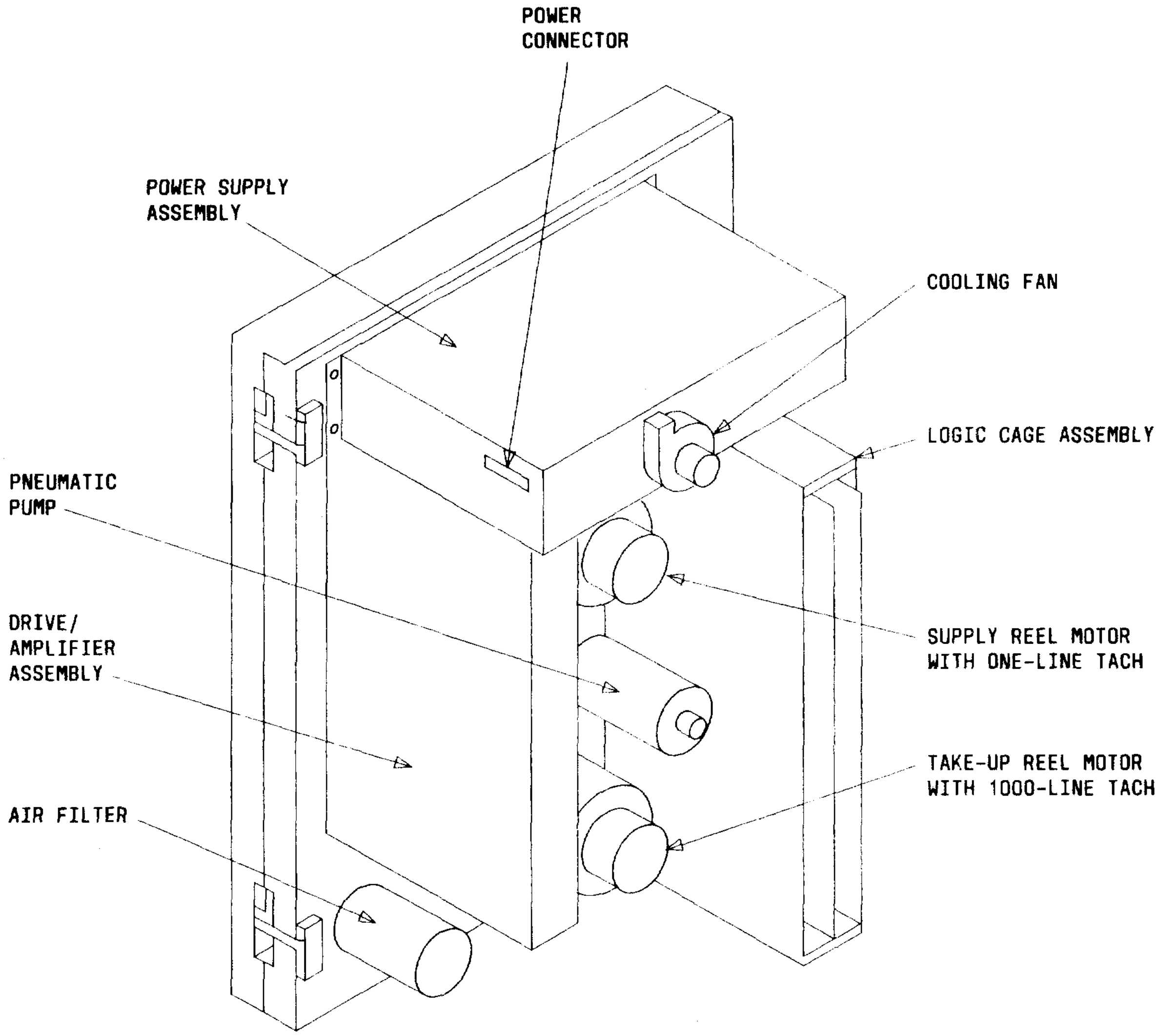


Fig. 6—Tape Deck (Rear View)

COOLING FAN

2.13 The cooling fan is a squirrel-cage type of assembly. The motor is compatible with either 120 or 240 volts. The cooling fan is provided to insure high reliability of the logic circuitry, power amplifier, and power supply.

POWER SUPPLY

2.14 The power supply consists of a line filter, circuit breaker, logic master clear, pneumatic pump motor control, cooling fan motor control, and voltage and current monitors. The power supply accepts the input ac voltage and converts it to +5, −6, +15, +25.5, and +38 Vdc output.

CIRCUIT BREAKER

2.15 The circuit breaker is located at the top right corner of the tape deck. It is used as an overcurrent protective device for the power supply circuit. In the OFF position, input power is removed from the power supply. To perform a power-up operation at the control panel, the circuit breaker must be on. The circuit breaker is rated at 10 amperes.

J1C134BA-1 INVERTER

2.16 The J1C134BA-1 inverter (300VA inverter) is mounted at the top of the tape unit frame. The 300VA inverter is 8.16 inches high, 10.5 inches wide, and 13.82 inches deep. It consists of a J1C134BA-1, L1, mounting plate and a J1C134BA-1, L2, inverter module. The mounting plate is 2 feet 2 inches wide and 10 inches high. It can accept two inverter modules. Inverter modules consist of a mounting plate, housing, backplane, 495H1 power converter, 393A sine wave synthesizer, and fuse blocks. The 300VA inverter uses 70A-type and 74E-type fuses to protect the internal circuits from drawing overcurrent. The 70A-type fuse has the maximum current of 1.33 amperes. The 74E-type fuse has the maximum current of 15 amperes. The 300VA receives −48 Vdc input from the power distribution frame and inverts the −48 Vdc to a 120-Vac output. The maximum input current of the inverter is 11 amperes.

3. FUNCTIONAL DESCRIPTION

3.01 The tape unit is a manual-load, reel-to-reel tape drive unit. It uses electronic circuits to control the movement of the magnetic tape between the supply reel and the take-up reel. A functional block diagram of the tape unit is shown in Fig. 7. The tape unit consists of the following functional areas:

- Formatter-control logic
- Read/write servo
- Read/write head assembly
- Pneumatic and cooling system
- Power supply and distribution.

FORMATTER/CONTROL LOGIC

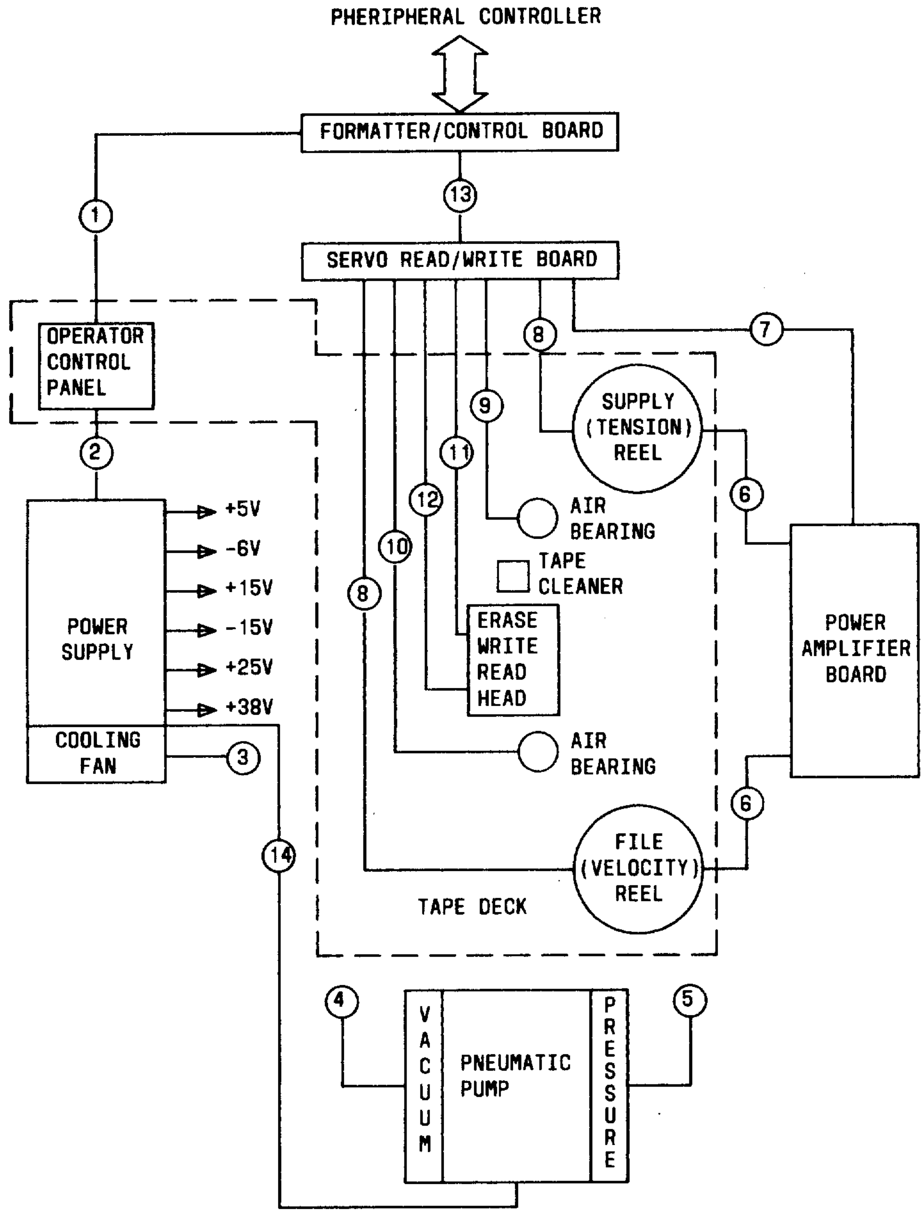
3.02 The formatter/control logic is a microprocessor-controlled unit. It accepts commands and data from the central control and processes the signals into an acceptable form for the tape unit. A functional block diagram of the formatter/control logic is shown in Fig. 8. The 6802 microprocessor provides control functions for the unit. The peripheral interface adapters (PIAs) interface the 6802 microprocessor with the associated circuits. The PIA 0 interfaces the formatter with the read/write servo board. The PIA 1 interfaces the 6802 microprocessor with the operator control panel. The PIA 2 interfaces the 6802 microprocessor with the peripheral controller. The PIA 3 controls the read logic and the PIA 4 controls the write logic on the formatter board. The programmable timer module (PTM) generates proper write clocks and a control line at preamble and postamble in the write operation. It also helps the microprocessor generate various amounts of delay during the read/write operations. The read-only memory (ROM) contains the functional and diagnostic program for the processor. It contains up to eight kilobytes of memory. The addressable latch and the multiplexer are used to increase the through-put capability of the processor.

READ/WRITE SERVO

3.03 The read/write servo provides a control for the servo system. The servo system consists of the tension servo, velocity servo, read/write circuit, and magnetic heads. The read/write servo is made up of a microprocessor and associated hardware. The microprocessor is based on the 6802 microprocessor chip. The read/write servo receives commands and data from the formatter. It interprets these commands and passes the control signals or data to the demanding circuit. Refer to Fig. 9 for a block diagram of the read/write servo. The microprocessor is a central processing unit. The programmable read-only memory (PROM) contains the functional and diagnostic programs for the read/write servo. The erasable PROM (EPROM) provides a means of storing the read amplifier gain values and velocity servo offset multipliers. The PIA interfaces the read/write servo with the formatter. The programmable timer module (PTM) provides a real-time clock and enables the processor to count the servo tachometers. The bit input multiplexer and the output latches interface the microprocessor with the servo, read, and write hardwares. The tension servo provides a control for the take-up reel motor.

OPERATOR CONTROL PANEL

3.04 The operator control panel (Fig. 4) includes switches, indicators, and a display, which are accessed from the front of the tape unit. The operator control panel is provided for manual control and diagnostic purposes. The functions of the switches and indicators are listed in Table A.



1. OPERATOR/DIAGNOSTIC COMMANDS
2. ON/OFF SWITCHES AND PANEL INDICATOR VOLTAGES
3. COOLING AIR TO ALL ASSEMBLIES
4. VACUUM SUPPLY TO TAPE CLEANER
5. PRESSURE TO AIR BEARINGS
6. DRIVE CURRENT TO REEL MOTORS
7. SPEED/TENSION CONTROL
8. TACH INFO TO SERVO CIRCUITS
9. BEARING TRANSDUCER TENSION INFO
10. BEARING TRANSDUCER VELOCITY INFO
11. WRITE DATA TO TAPE
12. READ DATA FROM TAPE
13. LOGIC CONTROL AND FORMATTING INFO
14. POWER TO PUMP MOTOR

Fig. 7—Tape Unit Functional Block Diagram

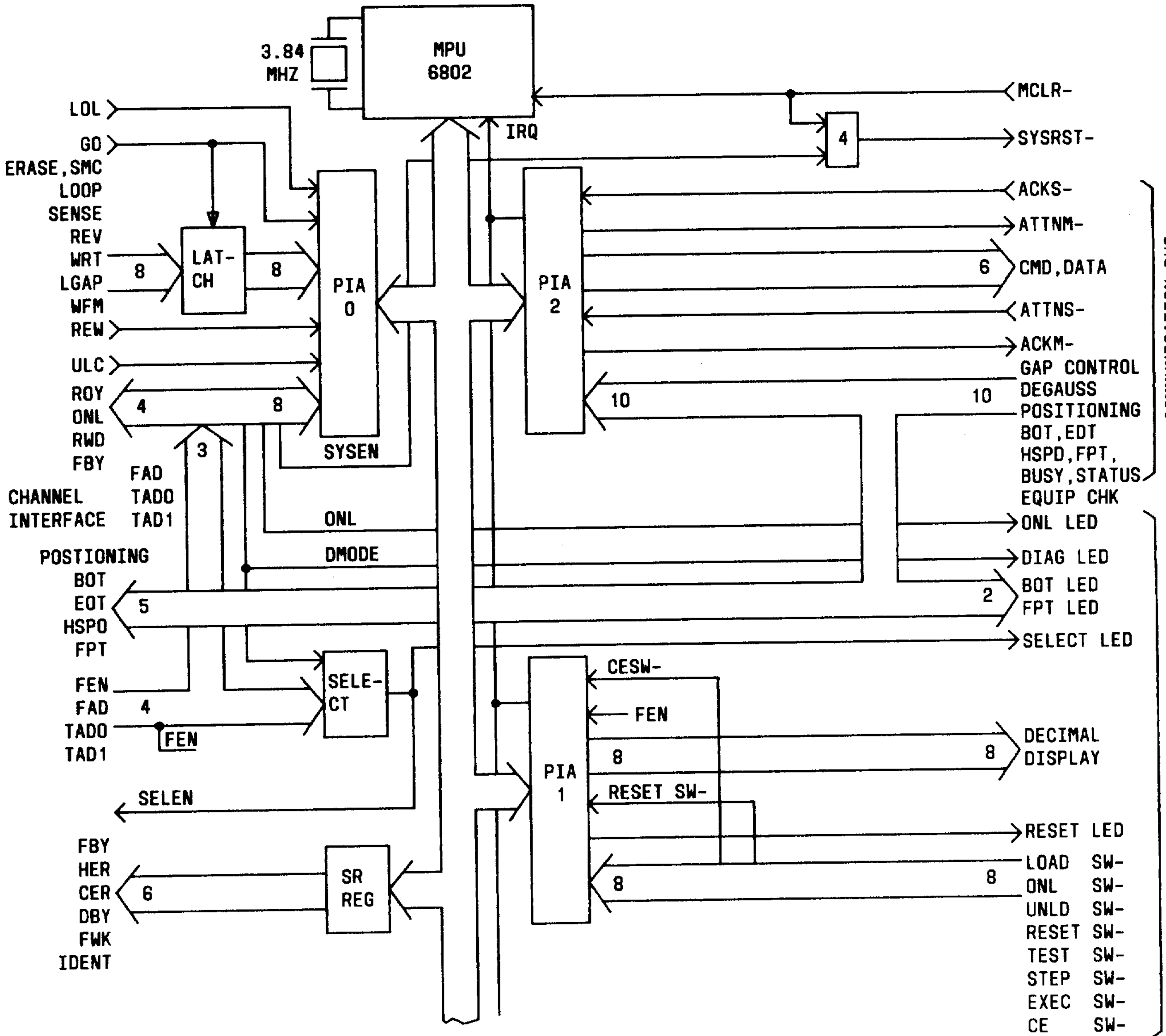


Fig. 8—Formatter/Control Block Diagram (Sheet 1 of 2)

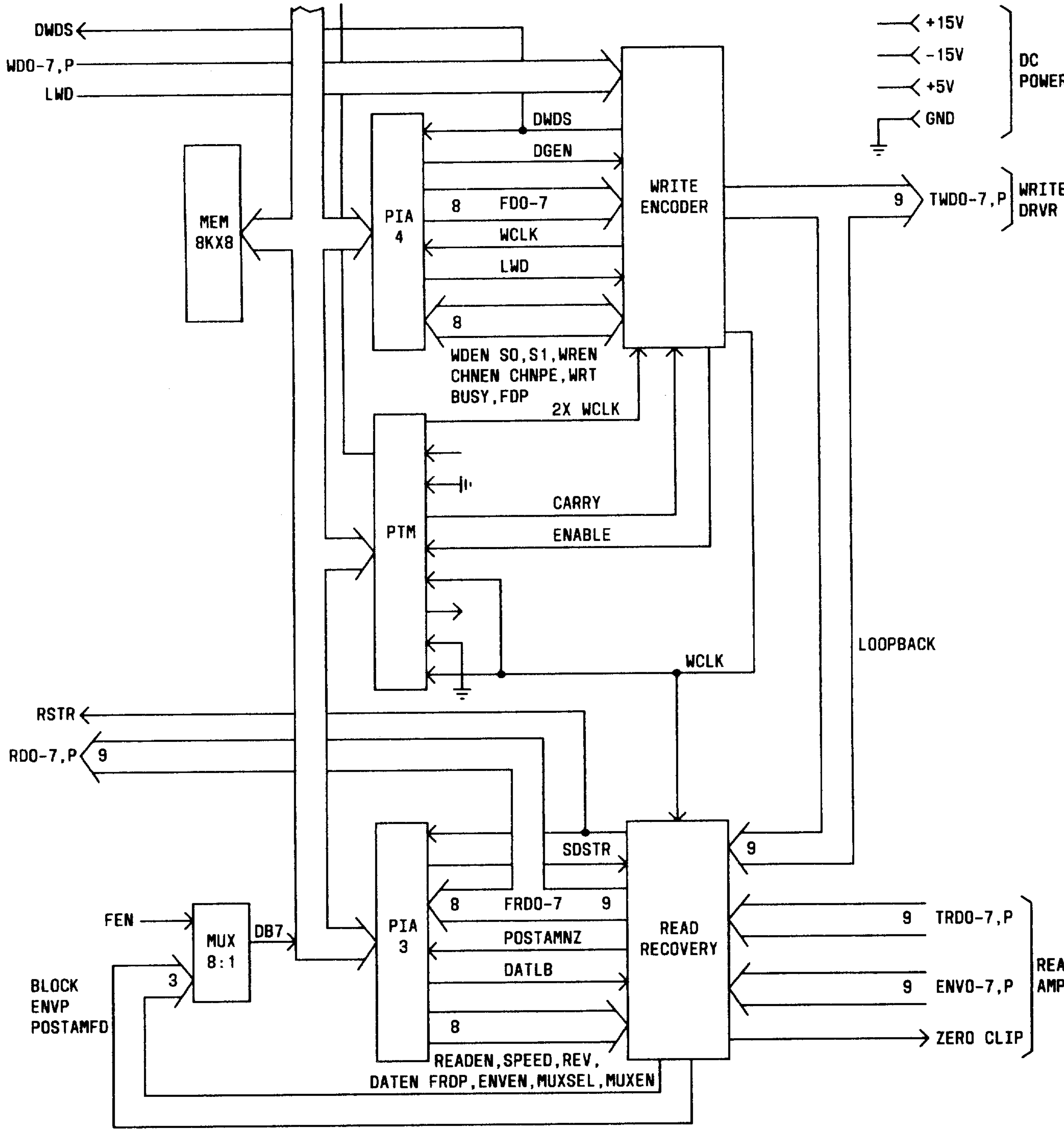


Fig. 8—Formatter/Control Block Diagram (Sheet 2 of 2)

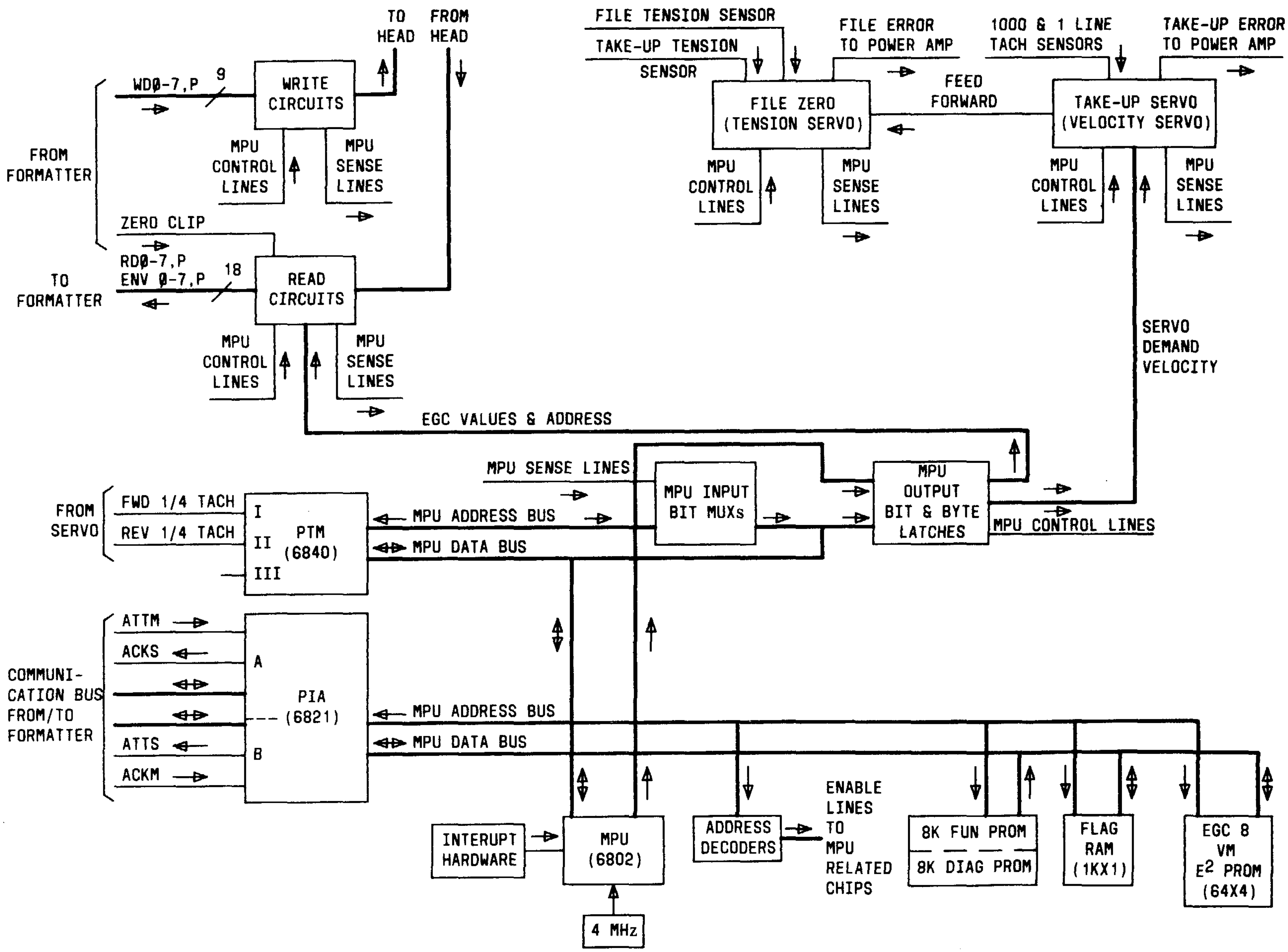


Fig. 9—Read/Write Servo Block Diagram

TABLE A

OPERATOR CONTROL PANEL

SWITCH	INDICATOR	FUNCTION
LOGIC OFF		If pressed when the tape unit is powered on, power will be removed from the tape unit and the LOGIC OFF indicator will light.
	LOGIC OFF	When lighted, indicates a standby power condition.
LOGIC ON		If pressed when the transport circuit breaker is on, the tape unit is powered on.
	FILE PRO	When lighted, indicates the absence of a write enable ring in the supply reel and write operation is inhibited in the tape unit.
	BOT	When lighted, indicates that the tape is positioned at the beginning of tape (BOT).
LOAD/REWIND		If the transport is powered on and tape is threaded, depressing the switch causes a load operation to be performed. If tape is loaded, depressing the switch causes a rewind operation to the BOT.
UNLOAD		If tape is loaded, depressing the switch causes the tape to unload from the take-up reel to the supply reel. If tape is threaded but not loaded, depressing the switch will cause the unit to slowly unload the tape onto the supply reel.
ON-LINE		If tape is loaded, depressing the switch causes the transport to go on-line and to become available for the system control.
	ON-LINE	When lighted, indicates that the tape unit is on-line.
RESET		Used to take the unit off line, stop tape motion, and clear error status. Certain control faults require a power-off or power-on sequence to clear.
	RESET	When lighted, indicates that a tape unit error condition exists.
	SELECT	When lighted, indicates that the unit is selected by the system.

TABLE A (Contd)

OPERATOR CONTROL PANEL

SWITCH	INDICATOR	FUNCTION
	TWO-DIGIT DISPLAY	The 2-character display is lighted when the tape unit is in off-line diagnostic/test mode. It displays diagnostic/test sequence numbers and results of tape unit microdiagnostic or exerciser routines when the tape unit is in off-line diagnostic/test mode. When the reset indicator is lighted, it displays either a diagnostic fault code or an on-line operational failure code.
	DIAGNOSTIC	When lighted, indicates that the unit is in the diagnostic/test mode.
TEST		Used to place the tape unit into a diagnostic/test mode when it is not on-line.
STEP		If the unit is in a diagnostic/test mode, the diagnostic/test sequence numbers can be entered by depressing this switch.
EXECUTE		If the tape unit is in a diagnostic/test mode, depressing the switch will initiate the microdiagnostic shown on the 2-digit display.
CE		If the tape unit is in a diagnostic mode, depressing the switch will initiate special microdiagnostics.*

* Diagnostics should be performed by trained personnel.

POWER SUPPLY

3.05 The power supply provides ac power for the cooling fan and pneumatic pump, generates dc power for the internal circuits of the tape unit, and provides shut-down capabilities in the event of abnormal voltage conditions. The power supply block diagram is shown in Fig. 10. The power supply receives 120-Vac input from the 300VA inverter. The line filter is used to reduce electrical noise coming in with the input voltage. The circuit breaker provides an overcurrent protection for the tape unit. It is also used as a manual power control for the unit. The voltage select board can be reconnected to be used with 220-Vac input (not required for use with J1C134BA-1, 300VA, inverters). The T1 transformer and rectifier provide standby voltages (+5V, +15V, and +20V direct current). The standby voltages are used only within the power supply. The +20 volts is used to develop the +15 volts and as a control voltage for the half-bridge switching converter and the control panel OFF indicator. The +15 volts (standby) is used as a supply voltage for the pulse-width modulation and K2 relay, and to develop the standby +5 volts. The +5 volts is used as a supply voltage for all TTL chips in the power supply. The CR9 triac and high-voltage rectifier accept 120-Vac input and then rectify and increase the 120 volts to approximately 300V direct current. The switching converter receives the 300 Vac input from the high-voltage rectifier. The pulse-width generator enables the switching converter to invert the 300 volts back to ac voltage via the T4 and T5 transformers. The rectifier and regulators rectify the ac outputs from the T4 and T5 transformers into +5V, −6V, ±15V, +25V, and +38V direct current. The +5V direct current is supplied to TTL circuits. The −6V direct current is supplied to the read amplifier circuits. The −15V direct current is supplied to the servos and power amplifier. The +15V direct current is supplied to the servos, power amplifier, and read recovery circuit. The +25V direct current is supplied to the write driver circuits. The +38V direct current is supplied to the power amplifier.

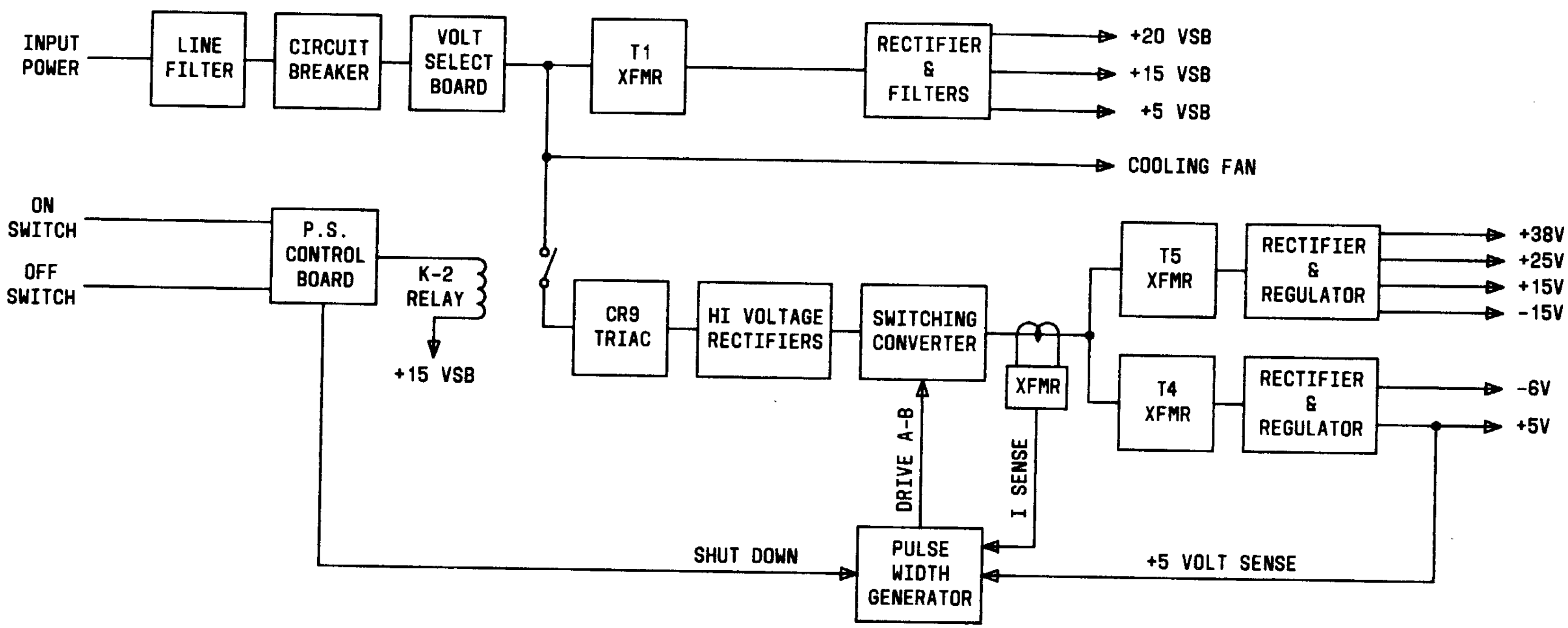


Fig. 10—Power Supply Block Diagram

POWER AMPLIFIER

3.06 The power amplifier accepts control signals from the read/write servo and provides current amplifications and overvoltage/undervoltage protections for the reel motors. The power amplifier consists of the following components:

- Triangular wave generator
- Bridge circuit for each reel motor
- Overvoltage/undervoltage protection
- Amplifiers and summing circuits
- Comparators and drivers.

A. One-Quadrant Operation

3.07 Refer to the power amplifier block diagram in Fig. 11. The error amplifier receives the analog signals (ERR and ERR RTN) from the formatter.The signals are isolated to eliminate the common ground between the power amplifier and the formatter. The isolated input signal (ERR) is summed with the negative current feedback (ICW and ICCW). The ratio of summation is 1-ampere output per 1-volt input. The summation amplifier amplifies the summed signal (ERROR) by a factor of 10. The inverted and noninverted signals are applied to two comparators along with a common triangular wave for developing pulse-width modulated signals. The driver drives the pulse-width signal to both sides of the bridge circuit. The bridge circuit operates in five different modes. The durations of the pulse-width signal are used to determine the state of the bridge circuit. The bridge circuit (Fig. 12) consists of four transistors (Qa, Qb, Qc, and Qd) and four diodes (CRa, CRb, CRc, and CRd). In state 1, transistors Qa and Qc are activated. At the same time, transistors Qb and Qd are turned off. In state 2, the transistor Qa is turned off while the transistor Qc is still on. State 2 occurs when the motor current is greater than the ERR input. In state 3, transistors Qb and Qd are activated while transistors Qa and Qc are turned off. The current of the motor in state 3 is in the opposite direction from the current of the motor in state 1. In state 4, transistor Qd and diode CRc are activated while transistors Qa, Qb, and Qc are turned off. The capacitor discharges current through diode CRd to the motor. The current from the motor returns to the capacitor via diode CRb.

B. Change of Quadrant

3.08 The error signal changes quadrant or sign when the input ERR voltage becomes less than the motor current. The change of sign causes two operations. In the first operation, the sign value, existing as 0 or 1, controls the bridge transistors (Qc and Qd) and gates the comparator signals (CW/CCW) to the bridge transistors (Qa and Qb). In the second operation, all four transistors (Qa, Qb, Qc, and Qd) are inhibited from conduction for 50 microseconds. Refer to Fig. 12. In this illustration, state 5 exists. After 50 microseconds, the motor current drops below the ERR input so that states 1 and 2 are reactivated. If, within the 50-microsecond period, the motor current does not fall below the ERR input, transistors Qb and Qd will conduct and continue to decrease the motor current. This condition exists when the ERR input has changed very rapidly or greatly in the opposite direction of the existing current.

PNEUMATIC SYSTEM

3.09 The pneumatic system (Fig. 13) generates and distributes the air pressure and vacuum to the tape unit. The pneumatic system consists of a carbon-vane centrifugal pump, tape cleaner intake port, tape deck plenum, filter and regulator assembly, and pressure ports of the air bearings. The vacuum effect at the tape cleaner is approximately 8 inches of water. The air pressure at the air bearing is 2 pounds per square inch (PSI). The filter and regulator assembly cleans and maintains the air pressure at 2 PSI and distributes it to the air bearing.

A. Air Bearings

3.10 The air bearings provide an air cushion allowing tape tension control over the record and playback surface of the magnetic head. Both upper and lower air assemblies provide guidance of the tape across the magnetic heads.

B. Tape Cleaner

3.11 The tape cleaner assembly consists of two sapphire blades and a vacuum port. The sapphire blades are set so that one cleans tape in the forward direction and the other cleans tape in the reverse direction. The vacuum port draws off the debris that is removed by the cleaner blade.

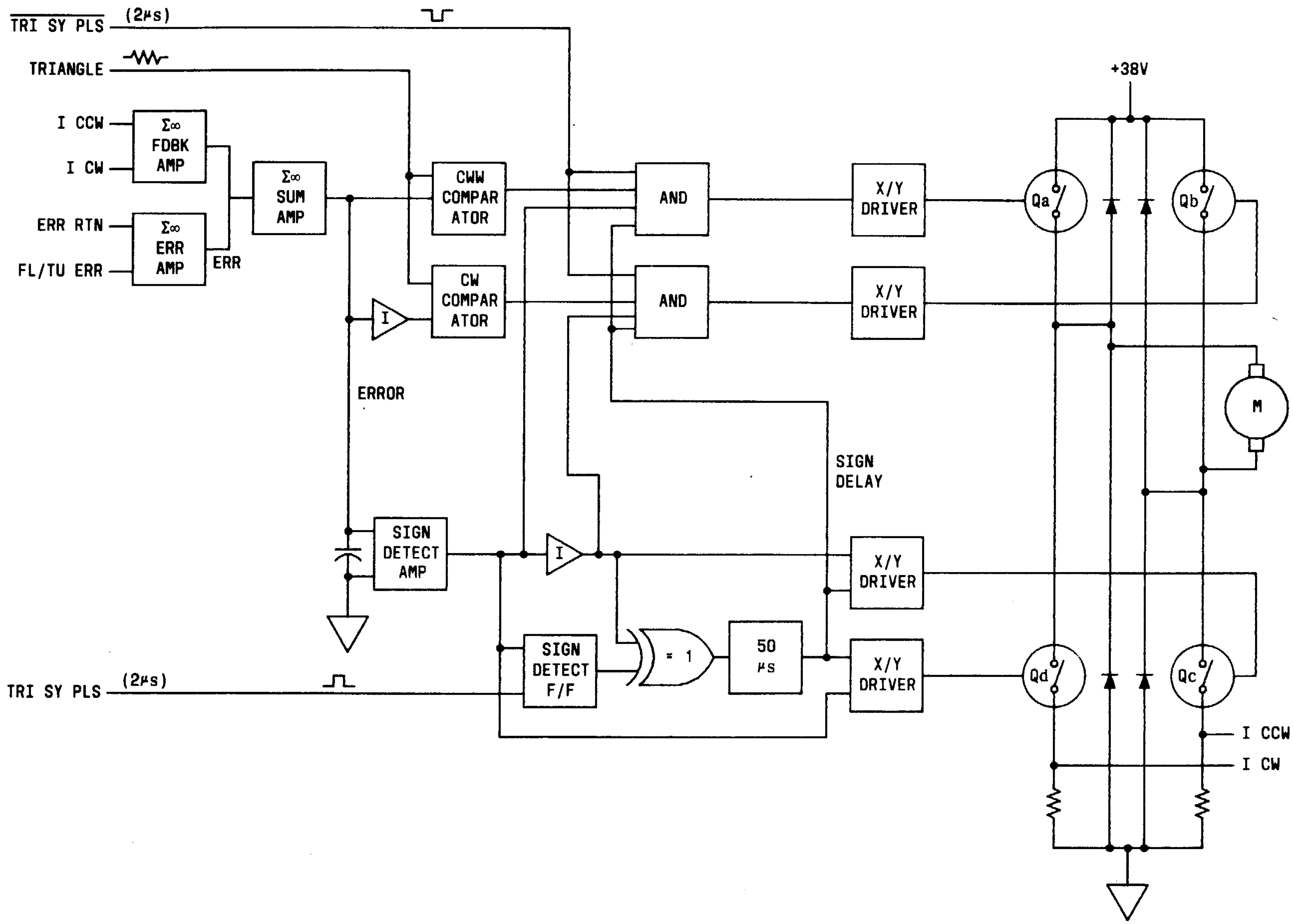
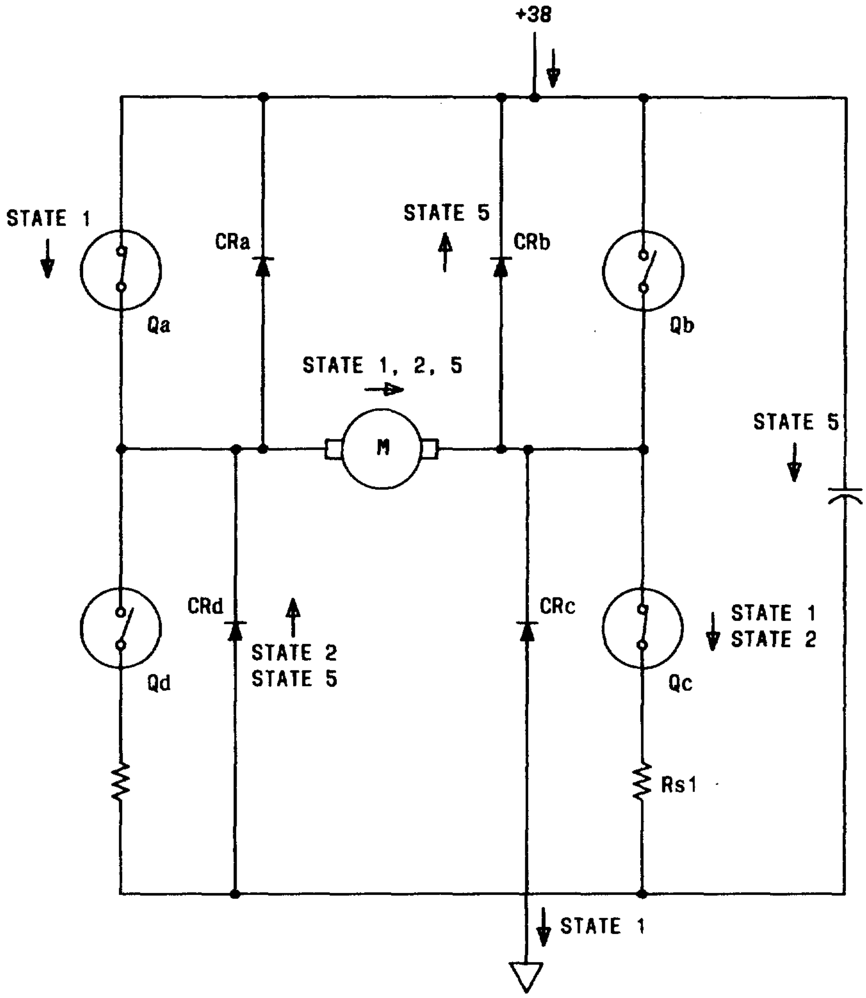


Fig. 11—Power Amplifier Block Diagram



STATE	ACTIVE COMPONENTS
1	Qa → M → Qc
2	M → Qc → CRd → M
3	Qb → M → Qd
4	M → Qd → CRc → M
5	C → CRd → M → CRb → C

Fig. 12—Bridge Circuit

C. Pneumatic Pump, Filter, and Regulator

3.12 The pneumatic pump is an ac induction motor with a 4-blade pump. The pressure output is routed to the filter via the deck casting where any particles are removed before distibution to the air bearings. The piston-type pressure regulator, which maintains a constant pressure to the upper and lower air bearings, is mounted directly onto the filter. The vacuum portion of the pump draws air from the tape cleaner. The wiring diagram of the pump motor is shown in Fig. 14.

4. THEORY OF OPERATION

GENERAL RECORDING REQUIREMENTS

4.01 The format of recording is 1600 bits per inch in a phase-encoded method. This format meets the qualifications of the American National Standard Institute (ANSI), Article X3.39-1793. Characteristics of the recorded tape are provided in Table B.

A. Reflective Tape Markers

4.02 Every reel of magnetic tape must have a beginning-of-tape (BOT) and end-of-tape (EOT)

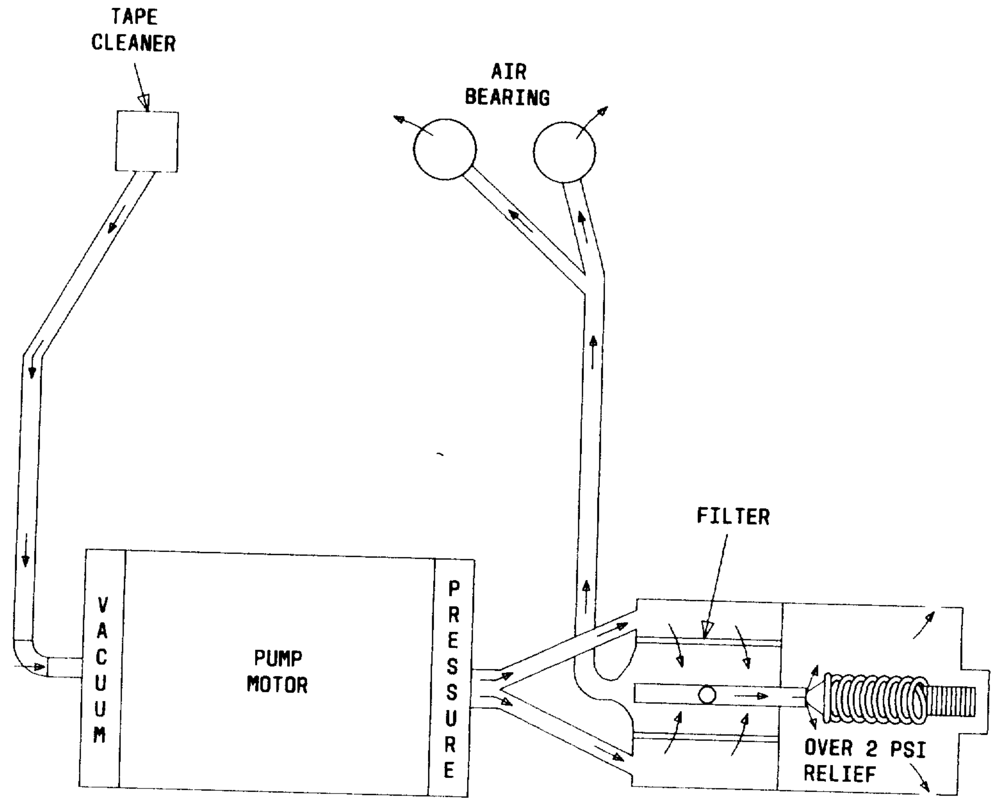


Fig. 13—Pneumatic System

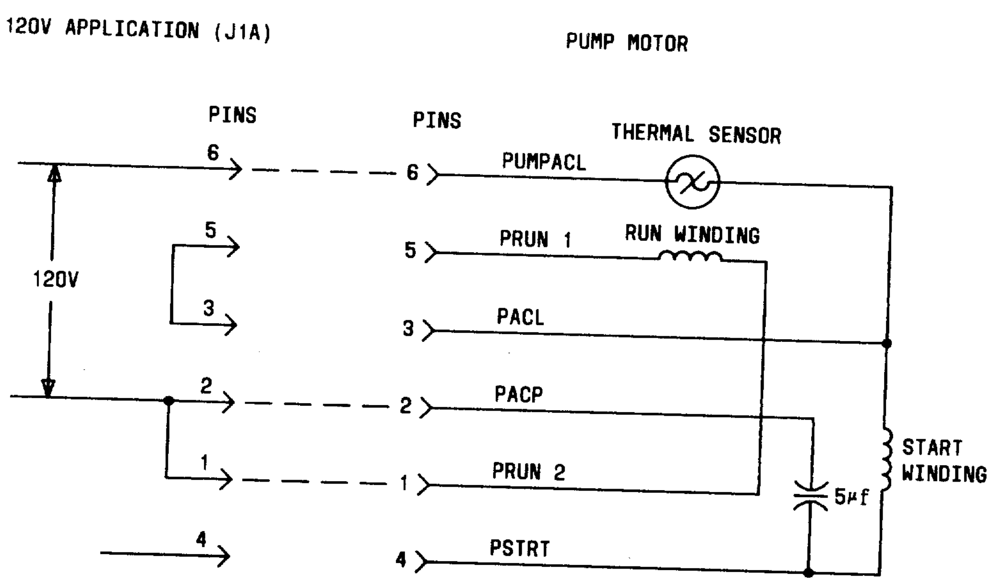


Fig. 14—Pump Motor Wiring Diagram

TABLE B

TAPE CHARACTERISTICS

ITEM	CHARACTERISTIC
Tape width	0.5 inch
Tape thickness	1.5 mils
Tape tension	8 ounces
Reel diameter	10.5 inches (maximum)
Reel capacity	2500 feet (maximum)
Number of tracks	9 parallel
Density	1600 bits per inch for each track
Tape speed (nominal) Low-speed start/stop mode Low-speed streaming mode High-speed streaming mode	 25 inches per second 25 inches per second 100 inches per second
Speed variation Start/stop mode Streaming mode	 5-percent maximum instanteneous speed variation 3 percent maximum long-term speed variation
Rewind time (maximum)	2.75 minutes
Load time (maximum)	15.0 seconds
Start/stop distance (nominal) Low-speed start/stop mode Low-speed streaming mode High-speed streaming mode	 0.25 inch 0.5 inch 8.0 inches
Data transfer rate Low-speed mode High-speed mode	 40 kilobytes per second 160 kilobytes per second
Write Interblock Gap Size 1. Short Gap Low-speed start/stop mode Low-speed streaming mode High-speed streaming mode 2. Variable short gap High-speed streaming mode 3. Variable long gap High-speed streaming mode	 0.8 inch (nominal) 0.6 inch (nominal) 0.8 inch (maximum) 0.6 inch (nominal) 0.6 through 0.9 inch 0.6 through 1.2 inches

TABLE B (Contd)

TAPE CHARACTERISTICS

ITEM	CHARACTERISTIC
Read interblock gap size All modes (minimum) Streaming mode (maximum)	 0.5 inch 1.2 inches
Write access time (nominal) Low-speed start/stop mode Low-speed streaming mode High-speed streaming mode	 22 milliseconds 66 milliseconds 175 milliseconds
Read access time (nominal) Low-speed start/stop mode Low-speed streaming mode High-speed streaming mode	 24 milliseconds 66 milliseconds 175 milliseconds
Reposition time (nominal) Low-speed streaming mode High-speed streaming mode	 221 milliseconds 670 milliseconds
Position time (nominal) Low-speed streaming mode High-speed streaming mode	 156 milliseconds 495 milliseconds
Reinstruction time (nominal) 1. Low-speed streaming mode Write (short gap) Read (short gap) 2. Start/stop mode Write Read	 14 milliseconds for 0.6-inch gap 22 milliseconds for 0.8-inch gap 20 milliseconds for 0.5-inch gap 24 milliseconds for 0.6-inch gap 0 millisecond 0 millisecond

reflective marker so that the transport can recognize starting and stopping areas. Tapes are always supplied with reflective markers installed. However, if the markers become detached for any reason or if the tape leader is shortened because of tape damage, the operator must install a marker as shown in Fig. 15.

B. System and Timing Considerations

Motion Characteristsics

4.03 The tape unit has two operational speeds: 25 inches per second and 100 inches per second. Selection of either speed is made at the tape unit interface (the UN52 controller). The speed of 25 inches per second is a default mode. At a speed of 100 inches per second, the tape unit only performs in the streaming mode. At the speed of 25 inches per second, the tape unit either performs in the start/stop or streaming mode.

Start/Stop Mode

4.04 In the start/stop mode (Fig. 16), the tape unit operates similarly to a conventional half-inch tape unit. It accelerates the tape when it receives a command and stops the tape within the interblock

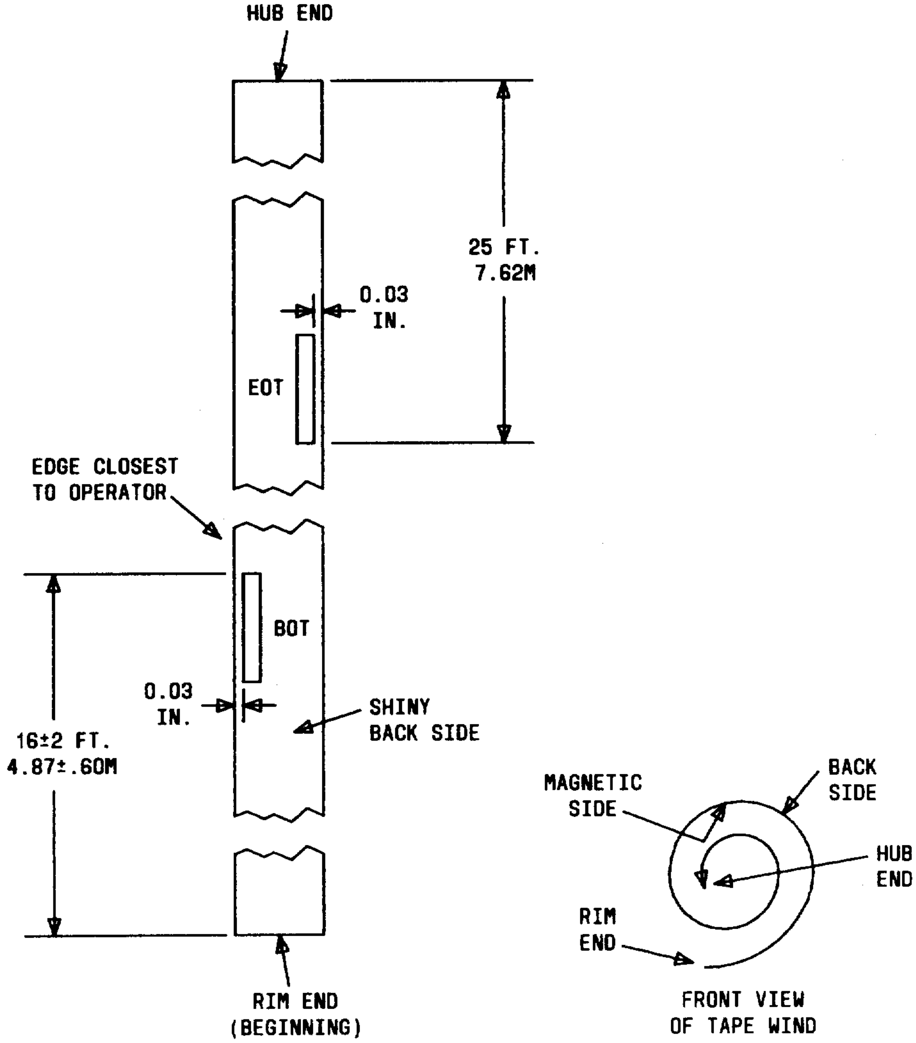


Fig. 15—Location of Reflective Markers

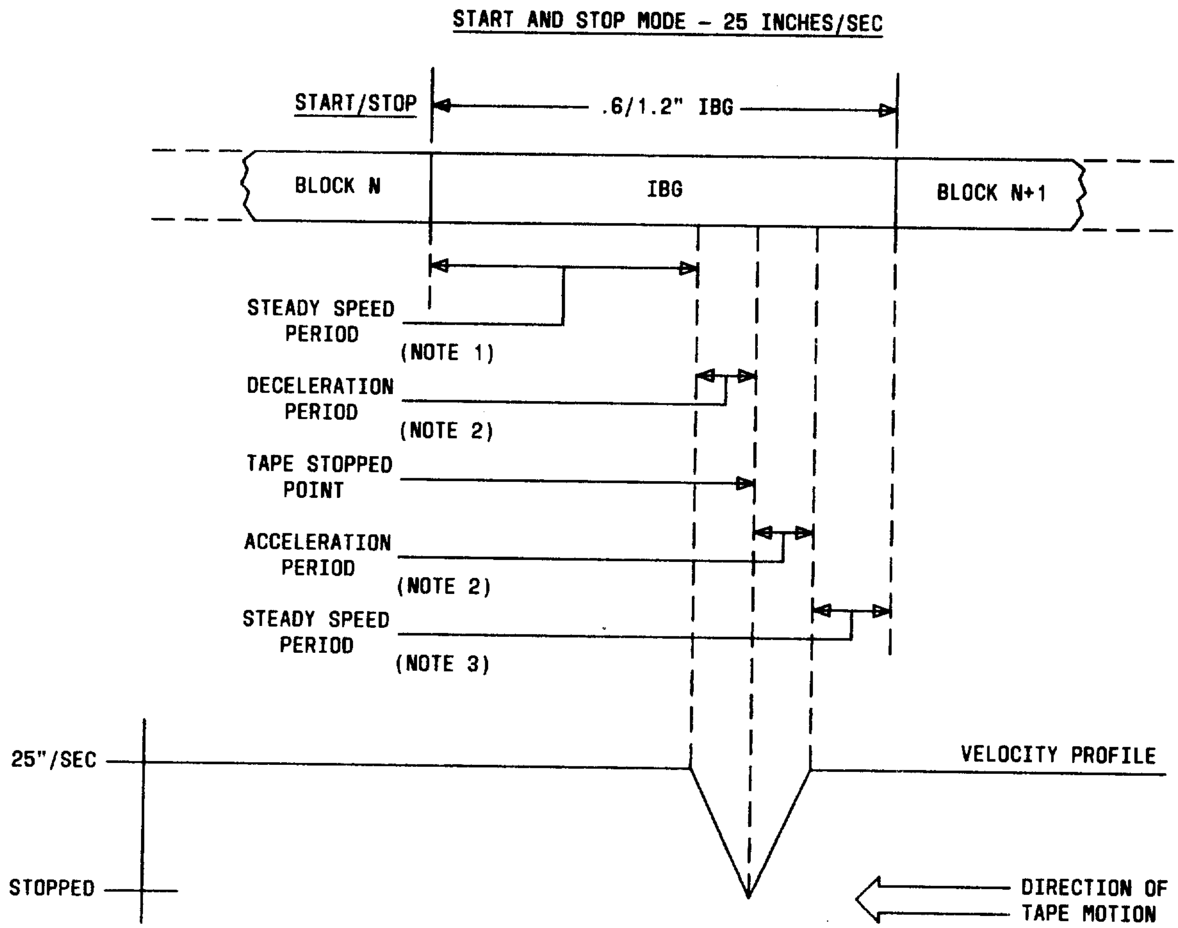
gap. The interblock gap is 0.8 inch long. The start/stop mode includes the following operations:

- Read operation
- Write operation.
- Other start/stop motion. In the start/stop mode, the tape will stop between records regardless of reinstruction timing.

4.05 ***Read Operation:*** During the read operation cycle, after a block has been successfully traversed, the tape will be brought to a complete stop to await the next command. The microprocessor, which resides in the read/write servo board, will delay the subsequent commands if the time since the last start is less than 80 milliseconds.

4.06 ***Write Operation:*** In the write operation, the controlled operation is the same as in the read operation. The 80-millisecond restriction is still applied. The normal interblock gap in this mode is 0.8 inch.

4.07 ***Other Start/Stop Motion:*** Whenever a change from read to write mode is experienced, a jog operation is performed in order to position the erase within the interblock gap. The time to execute the jog operation is normally 191 milliseconds. When changing from write to read reverse or rewind, a forward jog to erase a full gap is inserted by the transport. This insures that there will



NOTES:
1. 0 mS FOR .6" IBG; 24 mS FOR 1.2" IBG
2. 20 mS NOMINAL
3. 4 mS NOMINAL

Fig. 16—Start/Stop Mode Tape Motion Control

be no glitch in the initial gap when the write head is turned off. Time to execute the forward jog is 120 milliseconds.

Streaming Mode

4.08 The streaming mode is a high-performance operating mode. It provides continuous transfers of many data blocks to or from the tape. In the streaming mode, one interblock gap is not sufficient to contain the command for acceleration and deceleration of the tape. Therefore, the system sustains the tape motion by issuing subsequent commands to the tape transport during the time the transport is traversing the interblock gap (Fig. 17). The transport receives commands in three different modes as follows:

(a) During reinstruction interval

(b) During repositioning cycle

(c) Following repositioning cycle.

4.09 In the streaming mode, if the transport receives a command during the reinstruction interval (Fig. 18), the velocity of the tape motion will maintain without interruption through the processing of blocks N and N+1.

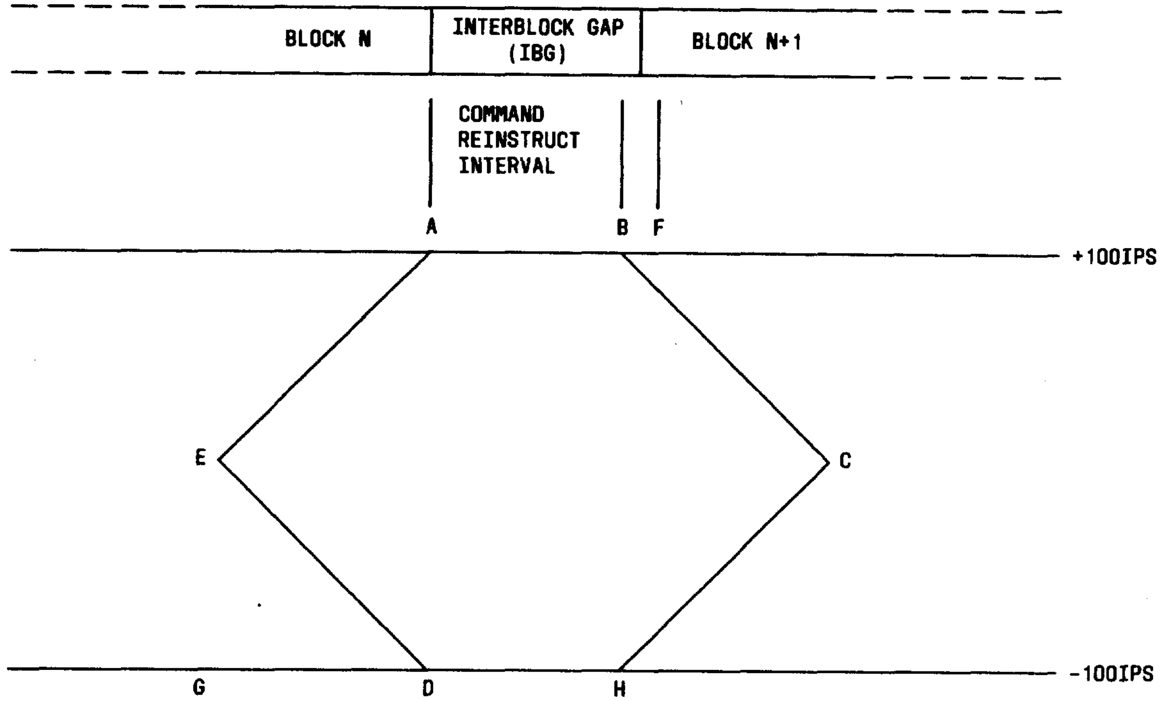


Fig. 17—Streaming Mode Velocity Diagram

4.10 In the streaming mode, if the transport receives a command during the reposition cycle, the tape will momentarily stop and change the direction (Fig. 19). The velocity profile identifies the time sequence of events. The correspondence between the time and distance is shown in Fig. 20.

4.11 In the streaming mode, if the transport receives a command following the repositioning cycle, the tape motion will stop and wait for the new command (refer to Fig. 21 at point E1 to E2). The tape motion will start at point E2 if the transport receives a new command. The correspondence between time and distance is shown in Fig. 22.

4.12 Tape motion continues without loss of time due to starting and stopping if the next command is received during the command reinstruction time. The tape unit maintains 100-IPS speed through the interblock gap, anticipating the next command. If the transport receives a command within the reinstruction time, there is no loss of time due to starting and stopping. If commands arrive after reinstruction time or if the commands are discontinued, the transport will go through a recovery cycle. All read/write commands can be executed in this mode except read reverse, which is not an accepted command in the streaming mode.

4.13 ***Low-Speed (25 IPS) Mode Control:*** The tape unit will automatically switch between 25-IPS streaming mode and 25-IPS start/stop mode in response to the system usage. Essentially, when repositioning becomes excessive in the streaming mode, rather than continue to "thrash," the transport will switch to start/stop mode. The benefits of this change are significant. If the system cannot reinstruct to keep the unit in streaming mode, a 221-millisecond reposition cycle is required before processing of the next block of data can occur. In start/stop mode, the access time is reduced to 64 milliseconds in the worst case (if previous block of data is one byte) or to 24 milliseconds (if previous block of data is greater than 1.6 kilobytes). The transport will switch back to streaming mode when the command reinstruction time consistently reduces to a value that will allow the streaming mode. The following items are very important for this category:

(a) To avoid "jog" delays, mode switching is performed at a speed of 25 IPS, rather than in stationary. In essence, a mode switch takes effect at the end of the block in the process.

(b) If the time to traverse the preceding block, plus the reinstruction time, exceeds 60

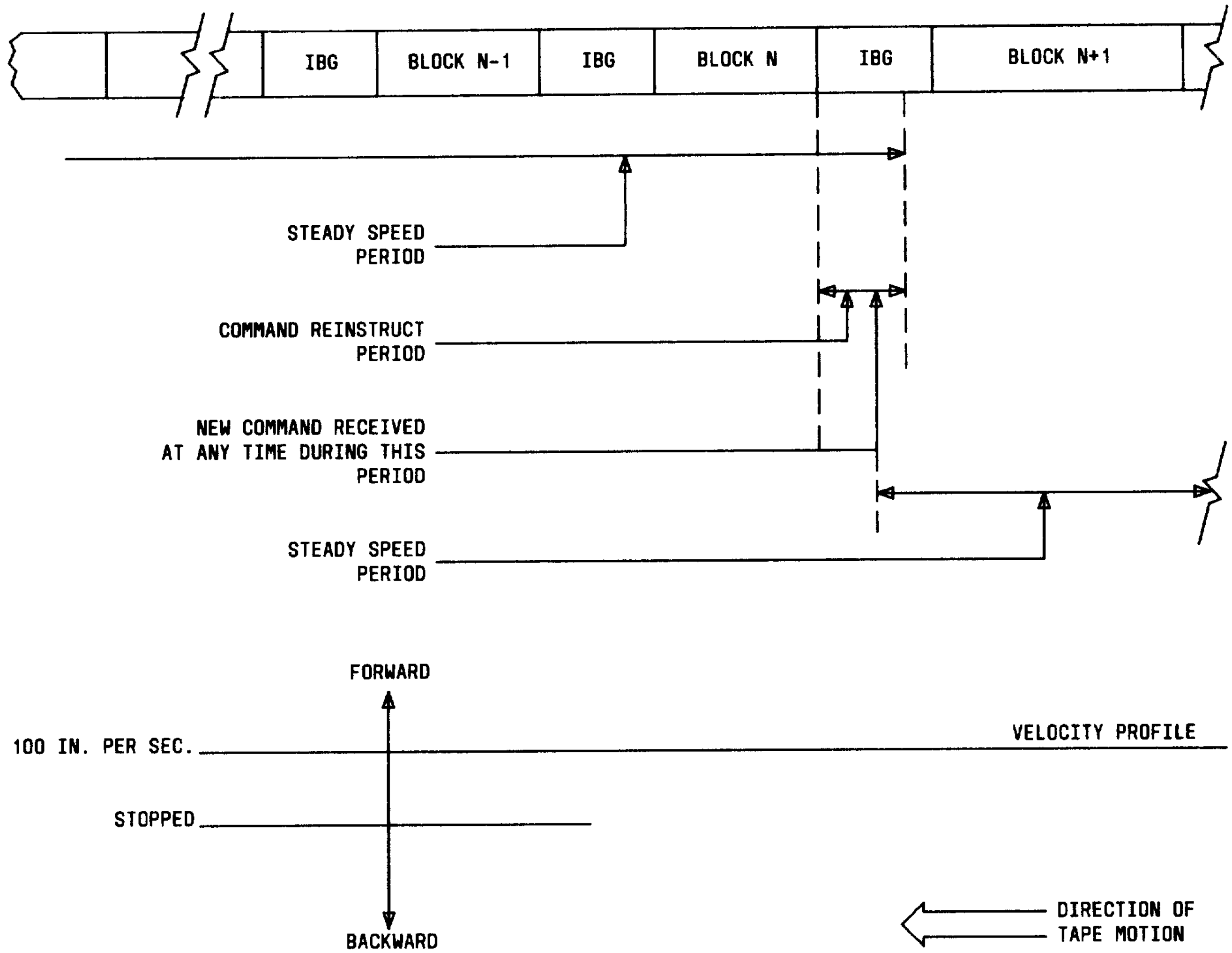


Fig. 18—Tape Motion Control (Nonstop)

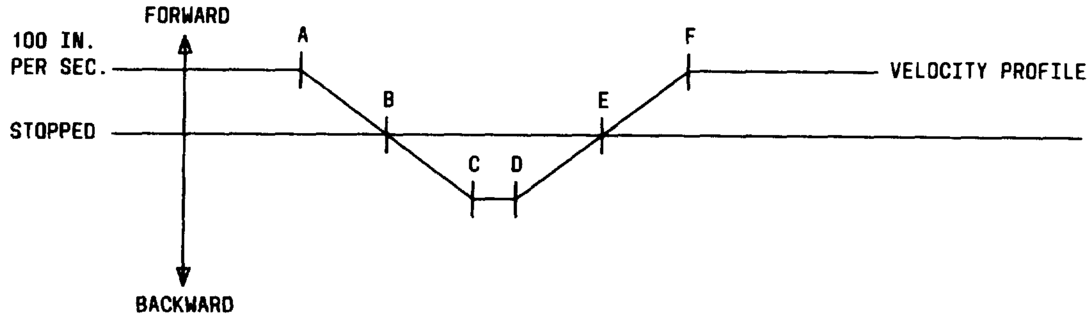
milliseconds, the access time will be 22 milliseconds for a write operation and 24 milliseconds for a read operation. The access time will be increased by the difference between 60 milliseconds and the time to traverse the preceding block, plus the reinstruction time, if the previous criterion is not met.

COMMAND CLASSIFICATION

4.14 The transport command set is placed into five categories dealing with the type of command being executed. These commands are as follows:

- Motion control (rewind)
- Mode control (on-line, off-line, or rewind)
- Data operation (read or write)
- Read sense (sense data transfer)
- Data loopback.

4.15 The motion and mode control commands are associated with the peripheral controller. The peripheral controller sends these commands over the interface bus to the tape transport. The data operation, read sense, and data loopback commands are associated with the formatter. The formatter transfers these commands via the FGO strobe sampling of the interface lines.



EVENT	VELOCITY PROFILE POSITION
STEADY SPEED PERIOD	UP TO POINT A
FORWARD MOTION DECELERATION	A-B
TAPE MOTION STOPPED MOMENTARILY	B
REVERSE MOTION ACCELERATION	B-C
FULL SPEED REVERSE MOTION	C-D
REVERSE MOTION DECELERATION	D-E
TAPE MOTION STOPPED MOMENTARILY	E
FORWARD MOTION ACCELERATION	E-F
STEADY SPEED FORWARD THROUGH DATA BLOCK N + 1	POINT F AND ON

Fig. 19—Streaming Mode Velocity Diagram (Momentary Stop)

4.16 The selected tape transport will respond to the following peripheral commands only after the "GO" pulse is initiated.

(a) ***Forward/Reverse:*** A logical true selects reverse operation. A logical false selects forward operation. A logical true means a TTL signal "low" exists on the bus lead between the peripheral controller and the tape drive, and the logical false means a TTL signal is "high."

(b) ***Read/Write:*** A logical true selects write mode, and logical false selects read mode.

(c) ***Write File Mark (WFM):*** A logical true (in the write mode) writes a file mark on the tape.

(d) ***High Speed:*** A logical true causes the selected transport to operate in the high-speed (100 inches per second) streaming mode.

(e) ***Last Word:*** A logical true indicates to the formatter that the present data character, which is placed on the input data lines, is the last character of the record.

(f) ***Formatter Enable:*** A logical false causes initialization of the formatter.

(g) ***Sense:*** A logical true allows the looping back of data transfers to the formatter for diagnostic of the bus.

4.17 The "rewind" command is a pulse that does not require the "GO" pulse to initiate. The rewind pulse causes the selected on-line transport to rewind the tape to the load point. This pulse will not cause a formatter busy signal to go to a logical true.

A. Formatter Response

4.18 The formatter provides the following status indications to the controller.

(a) ***Formatter Busy:*** This is a logical true that follows the trailing edge of the "GO" pulse when the peripheral controller issues the com-

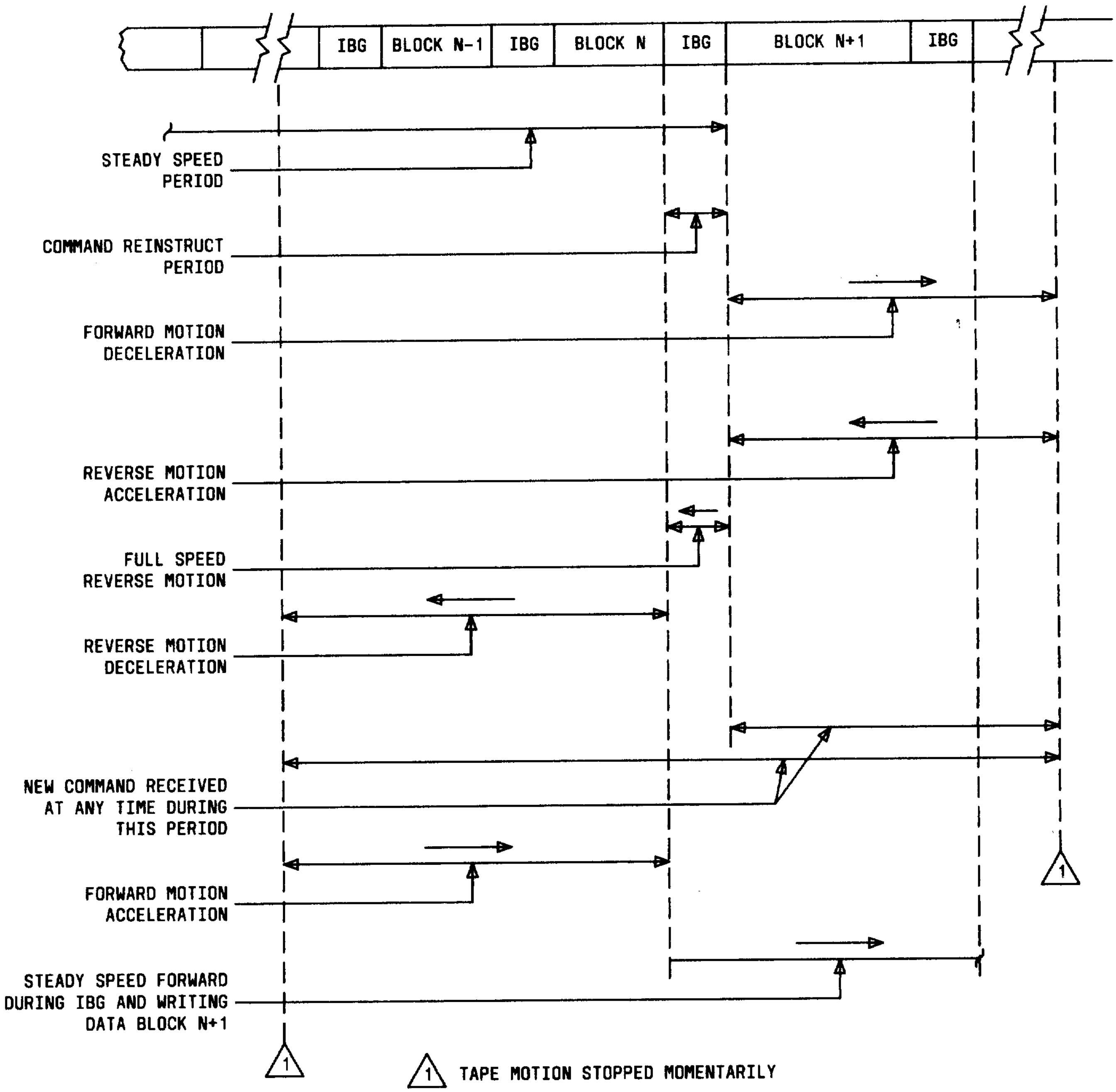


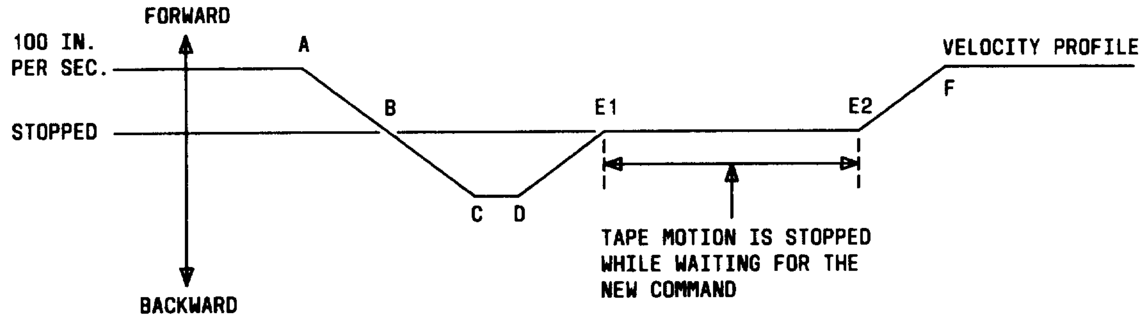
Fig. 20—Streaming Mode Tape Motion Control (Momentary Stop)

mand and inhibits further commands to the formatter.

(b) ***Data Busy:*** The data busy signal is logical true when the tape is up to speed, when the transport traverses the interblock gap, and when the formatter is about to write or read data to or from the tape. The data busy signal remains true until the data transfer and the post-record delay are completed.

(c) ***File Mark:*** This is a pulse that is generated when a completed file record has been detected on the tape during a read or write operation.

(d) ***Write Strobe:*** This pulse indicates that the write data lines are transferring an 8-bit data character and parity from the peripheral controller to the formatter.



EVENT	VELOCITY PROFILE POSITION
STEADY SPEED PERIOD	UP TO POINT A
FORWARD MOTION DECELERATION	A-B
TAPE MOTION STOPPED MOMENTARILY	B
REVERSE MOTION ACCELERATION	B-C
FULL SPEED REVERSE MOTION	C-D
REVERSE MOTION DECELERATION	D-E1
TAPE MOTION STOPPED WHILE AWAITING NEW COMMAND	E1-E2
FORWARD MOTION ACCELERATION	E2-F
STEADY SPEED FORWARD THROUGH DATA BLOCK N + 1	POINT F AND ON

Fig. 21—Transport Velocity Diagram (Receiving Command Following Repositioning Cycle)

(e) ***Read Strobe:*** This pulse indicates that the formatter reads an 8-bit data character and parity from the tape and puts it on the read data lines.

(f) ***Speed:*** This logical true pulse is used to indicate that the transport is in the high-speed streaming mode.

4.19 The following responses indicate status and configuration of the tape transport.

(a) ***Ready:*** This logical true pulse indicates that the tape is tensioned; is not rewinding, off-line, or loading; and is ready to receive a write command.

(b) ***On Line:*** If this pulse is logical true, it indicates that the tape transport is under remote control. If it is logical false, the transport is under local control.

(c) ***Rewinding:*** This true pulse indicates that the transport is in rewind operation or returning to the load point.

(d) ***File Protect:*** This logical true pulse indicates that the takeup reel has no write permit ring and that the write electronics are disabled.

(e) ***Load Point:*** When the load point reflective marker is under the photosensor and the transport is not rewinding, the load point signal will go to a logical true state.

(f) ***End of Tape (EOT):*** The EOT signal changes to a logical true state when the EOT marker is detected in the forward direction. The EOT signal remains true until the transport receives a rewind command.

B. Error Detection

4.20 The formatter provides the following types of error detection responses:

- Corrected error
- Hard error.

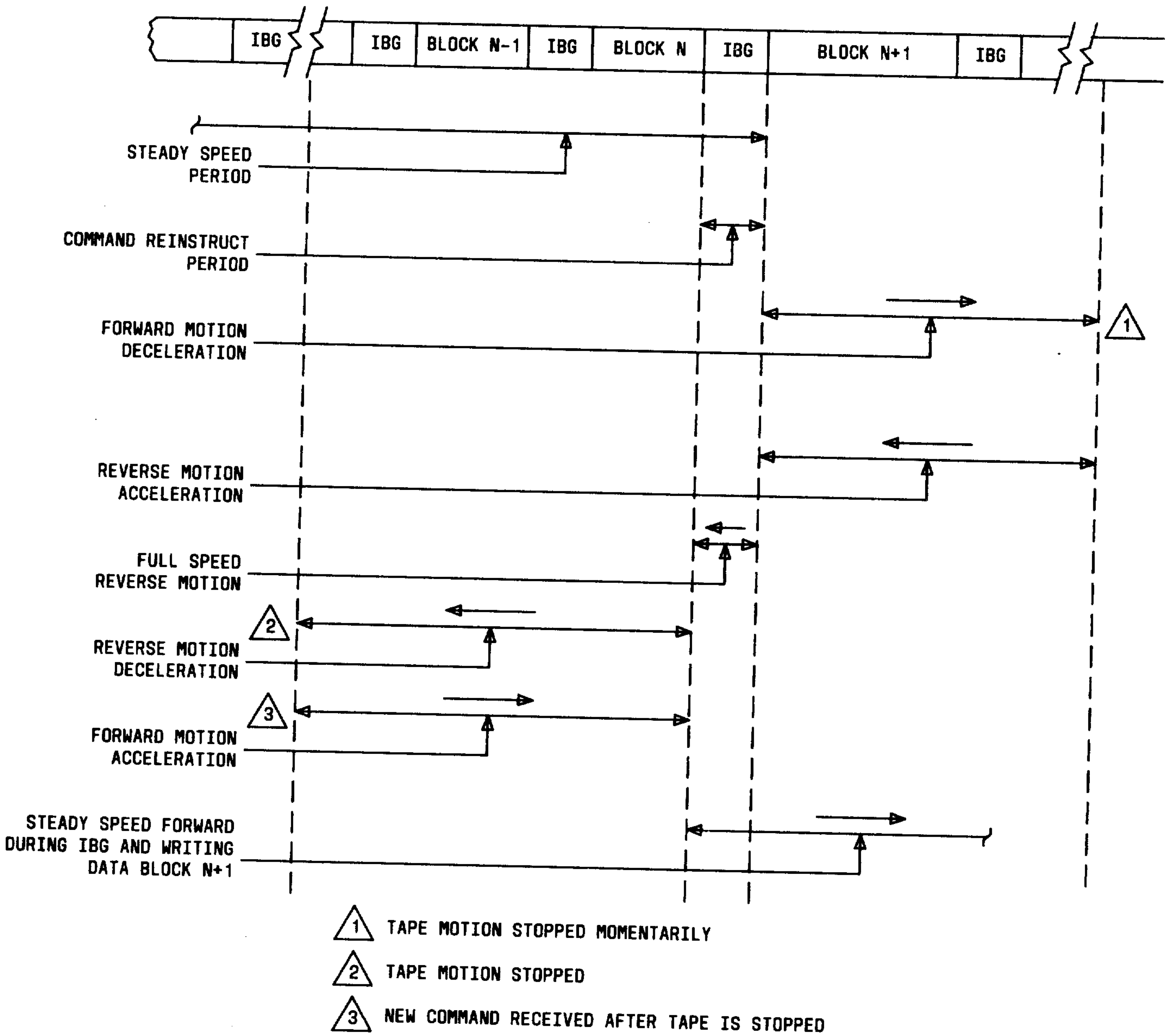


Fig. 22—Tape Motion Control (Receiving Command Following Repositioning Cycle)

4.21 The corrected error indicates that a single track error has been detected during a read operation and that corrected data is being sent. The hard error indicates that an uncorrectable error has occurred and that the record should be reread or rewritten.

5. DIAGNOSTIC

PERIPHERAL CONTROLLER RESIDENT BOOT DIAGNOSTIC

5.01 A small amount of diagnostic code will reside in the read-only memory of the peripheral controller. This diagnostic code will be used for initialization and verification of basic functions when bringing up the peripheral controller diagnostic.

5.02 The central control contains the peripheral controller diagnostic. It pumps the diagnostic routine into the peripheral controller under the system command. The diagnostic routine will thoroughly test the peripheral controller and give the result as a passed or failed indication.

FORMATTER DIAGNOSTIC

5.03 The formatter contains the diagnostic routine which features the following modes of testing:

- Basic test automatically performed when power is turned on.
- Continuous monitoring of vital operation parameters during all tape operations.
- Off-line tape motion diagnostic test.

6. REFERENCE

6.01 Refer to Section 254-302-000 for information relevant to this section.

7. ABBREVIATIONS

7.01 The following is a list of abbreviations used in this section.

ANSI—American National Standard Institute

AOT—Absence of Tape

BOT—Beginning of Tape

BPI—Bits per Inch

EOT—End of Tape

IOP—Input-Output Processor

IPS—Inch per Second

MP—Microprocessor

PIA—Peripheral Interface Adapter

PSI—Pound per Square Inch

PTM—Programmable Time Module

RAM—Random Access Memory

ROM—Read-Only Memory

TTL—Transistor-Transistor Logic